SOME CONCLUSIONS DRAWN FROM A BASINAL ANALYSIS OF THE ECCA SERIES IN THE KARROO BASIN

By P. J. Ryan

Introduction

This is a summary of a study made of the Ecca and lowermost Beaufort rocks in South Africa with particular reference to the distribution of the various facies and their relationship to palaeocurrent trends. As a result of this the Ecca can be divided into four distinct facies, called the Northern, Southern, Western and Central Facies. The lowermost Beaufort is represented by sediments having the same distribution and origin as the first three facies of the Ecca. The maximum thickness of sediments described here is 11,000 feet.

Ecca and lower Beaufort Facies

(a) *The Ecca* (Figs. 1 and 2)

Sediments of the Northern Facies are confined to the Northern one-third of the basin, and are composed of bluish-black shale, coarse arkose, conglomerates and coal seams. Sediments constituting the lower and upper portions of this facies were deposited in a relatively deep water, continental sea environment, while the middle portion was deposited under fluviatile-deltaic conditions on a slowly subsiding cratonic shelf. The major source of these sediments lay to the East and Northeast of the present Natal Coast. These source rocks were predominantly granitic in composition as revealed by the heavy minerals and abundance of microcline felspars.

The Southern Ecca Facies is confined to the Karroo Trough and outcrops along the Southern structural margins of the basin as well as along the Transkei coast. It is composed of a thick sequence of greenish-grey and bluish-black shale, greywacke and sub-greywacke sandstone. Sedimentary structures indicate that the lower portion of the succession was deposited under deep-water conditions and that turbidity currents were active. Progressively shallower water conditions prevailed during deposition of the upper portion of the succession and the facies as a whole was deposited in a rapidly subsiding trough which formed part of the Cape-Karroo Geosyncline. Although the majority of the sediments were derived from a source lying South of the Southern Cape Folded Belt, transport also took place in an Easterly direction along the axial portion of the Karroo Trough. Heavy mineral studies and thin-section examination of these rocks indicate that their

source was not only predominantly granitic, but that sedimentary, metamorphic and basic igneous rocks also contributed to their formation.

The Western Ecca Facies occurs in the South-western portion of the Basin and is composed of bluish-black shale, sub-greywacke and greywacke sandstones. These sediments were deposited partly in the Western portion of the Karroo Trough and partly on the unstable shelf to the west of the Trough. The lower one-third of this facies was deposited under relatively deep water conditions while the upper two-thirds was deposited under fluvio-deltaic conditions. The source of these sediments lay to the West and South-west and was composed mainly of granitic rocks.

The Central Ecca Facies sediments were deposited in an extensive, moderately deep inland sea. These rocks actually are a mixture of the fine-grained facies equivalents of the other three facies, and derived from three different source areas.

(b) *The Beaufort*

The lowermost Beaufort Beds are composed of fine to coarse-grained sandstones interbedded with blue, green and occasionally maroon and purple shales and mudstones. Three distinct facies, derived from separate sources, composed mainly of granitic rocks, are recognised within these beds. They have essentially the same distribution as the Southern, Western and Northern Facies in the Ecca Series, except that they do not grade into a facies composed entirely of shale. Instead the lithological units constituting the various facies interfinger with each other towards the central portion of the basin. The rocks of the lowermost Beaufort were deposited in an aqueous continental environment.

Palaeogeographical reconstructions indicate that the present South African sub-continent was more extensive during deposition of the Ecca and lowermost Beaufort Beds. In Lower Ecca times the Karroo Basin was probably connected to the oceans by means of two narrow openings, one situated in the South Eastern portion of the Basin and the other in the vicinity of the present Orange River Mouth (Fig. 3).

Acknowledgments

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Explanation of Text Figures

Fig. 1: Facies distribution Map of the Ecca Series in the Karroo Basin.

Fig. 2: Interpretive palaeocurrent Map of the Ecca Series in the Karroo Basin.

Fig. 3: Tectonic framework of Southern Africa during the Ecca period.

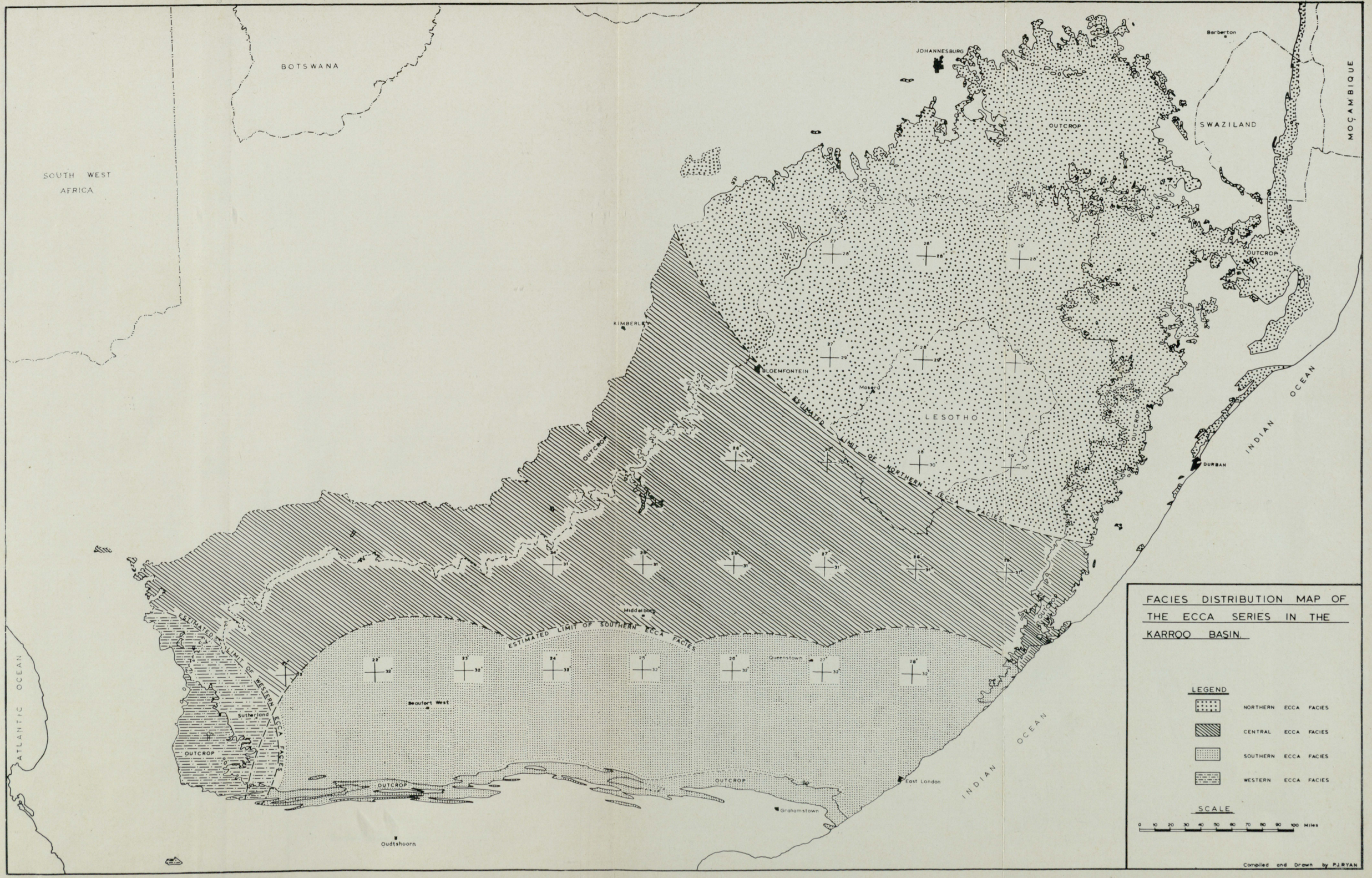
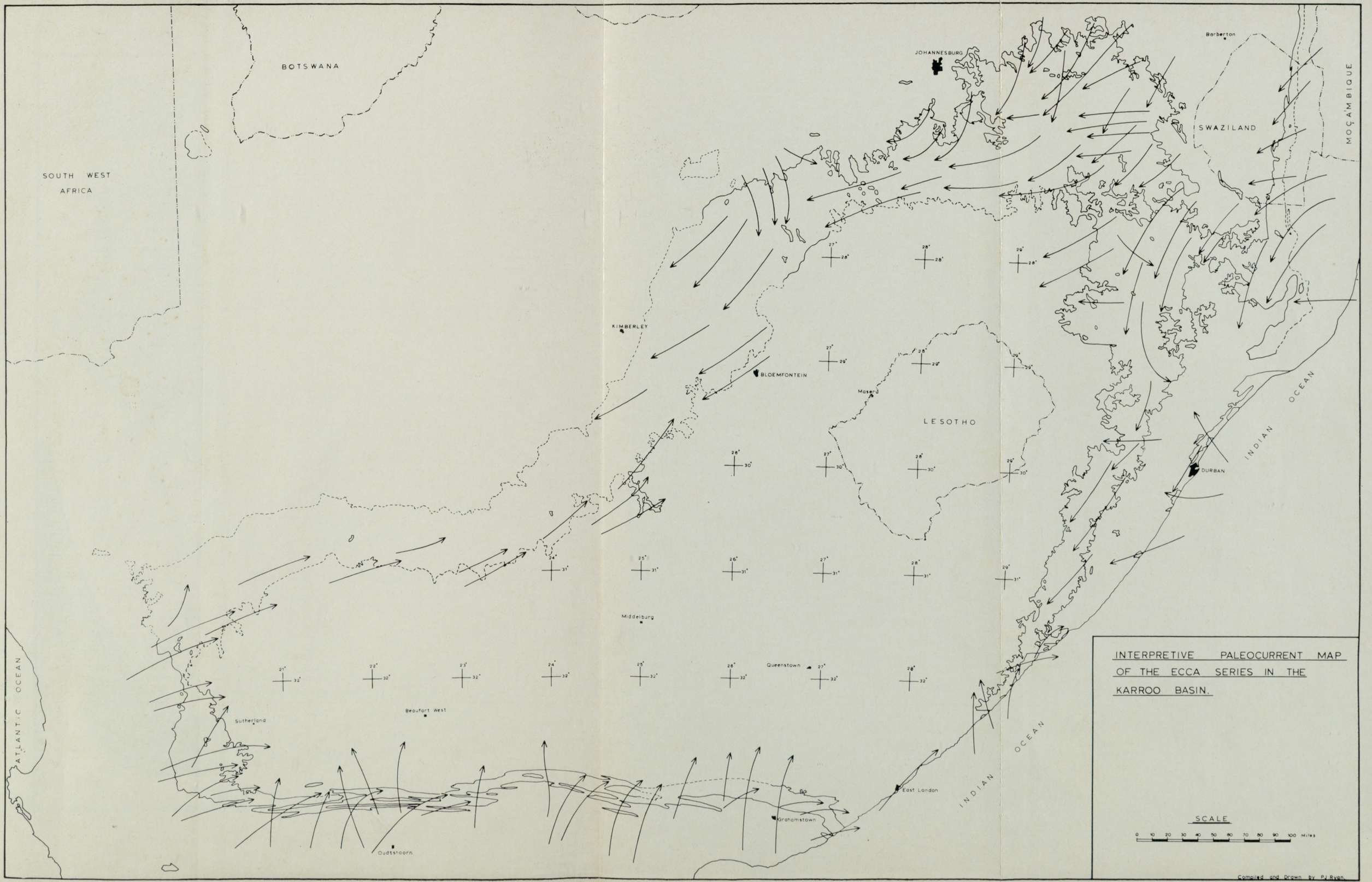

BOTSWANA
SOUTH WEST AFRICA
JOHANNESBURG
Barberton
SWAZILAND
MOÇAMBIQUE
OUTCROP
KIMBERLEY
BLOEMFONTEIN
Masaru
LESOTHO
ESTIMATED LIMIT OF NORTHERN ECCA FACIES
ESTIMATED LIMIT OF SOUTHERN ECCA FACIES
ESTIMATED LIMIT OF WESTERN ECCA FACIES
Middelburg
Queenstown
Beaufort West
Sutherland
East London
Grahamstown
DURBAN
Oudtshoorn
ATLANTIC OCEAN
INDIAN OCEAN
FACIES DISTRIBUTION MAP OF THE ECCA SERIES IN THE KARROO BASIN.
LEGEND
NORTHERN ECCA FACIES
CENTRAL ECCA FACIES
SOUTHERN ECCA FACIES
WESTERN ECCA FACIES
SCALE
0 10 20 30 40 50 60 70 80 90 100 Miles
Compiled and Drawn by P.J.RYAN

Fig. 1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LESOTHO
DURBAN
INDIAN OCEAN
Middelburg
Queenstown
Beaufort West
Sutherland
Oudtshoorn
Grahamstown
East London
ATLANTIC OCEAN
INDIAN OCEAN
INTERPRETIVE PALEOCURRENT MAP OF THE ECCA SERIES IN THE KARROO BASIN.
SCALE
0 10 20 30 40 50 60 70 80 90 100 Miles
Compiled and Drawn by P.J. Ryan.

Fig. 2

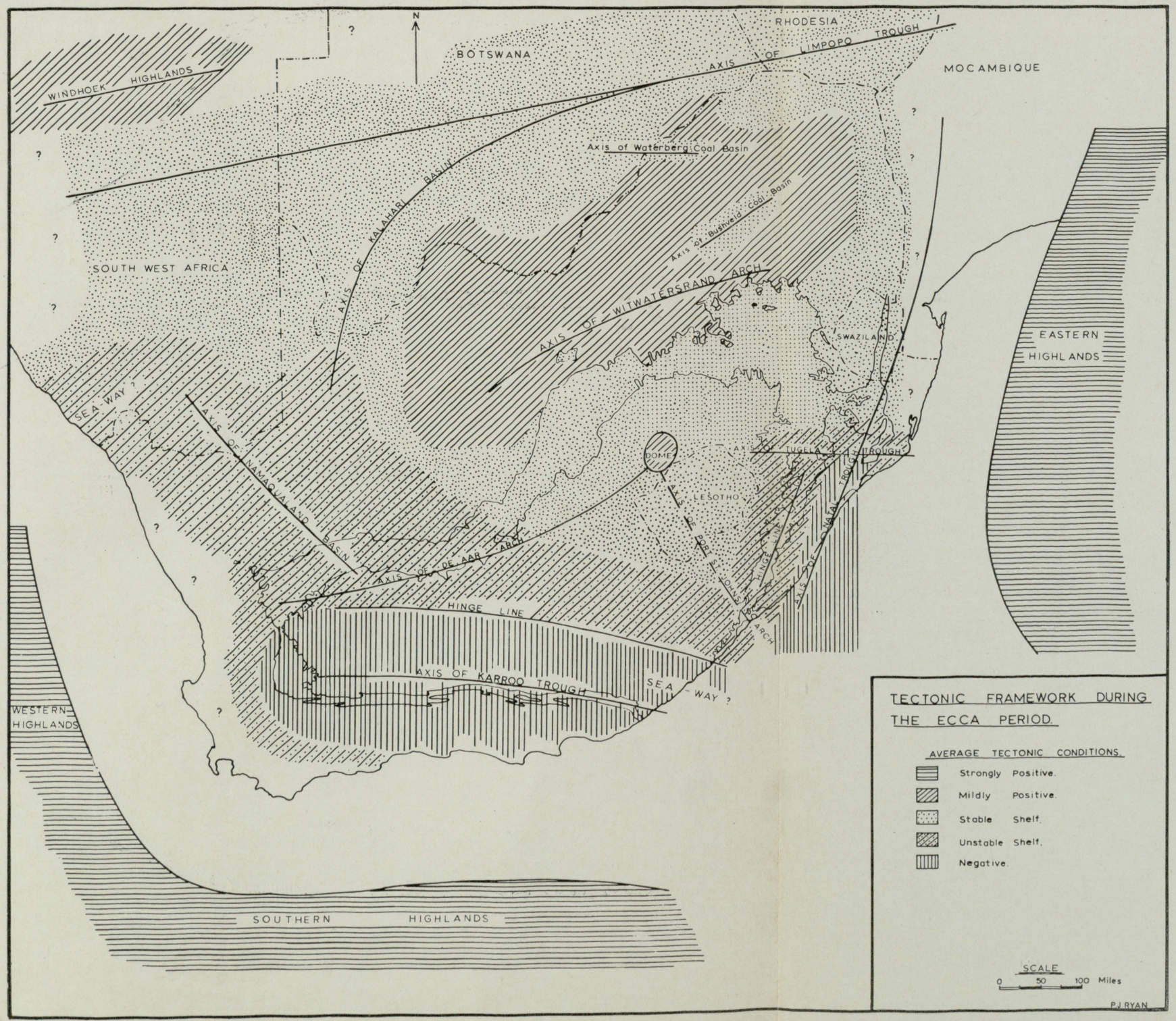
N
RHODESIA
BOTSWANA
MOCAMBIQUE
WINDHOEK HIGHLANDS
AXIS OF LIMPOPO TROUGH
Axis of Waterberg Coal Basin
AXIS OF KALAHARI BASIN
Axis of Bushveld Coal Basin
SOUTH WEST AFRICA
AXIS OF WITWATERSRAND ARCH
SWAZILAND
EASTERN HIGHLANDS
SEA WAY ?
AXIS OF NAMAQUALAND BASIN
DOME
AXIS OF TUGELA TROUGH
LESOTHO
AXIS OF DE AAR ARCH
AXIS OF PORT ST JOHNS ARCH
HINGE LINE
AXIS OF KARROO TROUGH
SEA WAY ?
WESTERN HIGHLANDS
SOUTHERN HIGHLANDS
TECTONIC FRAMEWORK DURING THE ECCA PERIOD.
AVERAGE TECTONIC CONDITIONS.
Strongly Positive.
Mildly Positive.
Stable Shelf.
Unstable Shelf.
Negative.
SCALE
0 50 100 Miles
P.J RYAN.

Fig. 3